

WHAT IS CLAIMED IS:

1. A projection exposure apparatus comprising:

a projection optical system for projecting a pattern on a substrate;

5 a holding portion for holding an optical element which propagates light toward said projection optical system;

a mask which is arranged near an image plane or object plane of said projection optical system or a  
10 plane conjugate to the image plane and object plane and has a transmission portion;

an actuator for driving said mask along a plane of an image of said optical element formed by said projection optical system; and

15 a measurement device for measuring an intensity of light which emerges from said optical element, and passes through said projection optical system and the transmission portion of said mask while said mask is driven.

20 2. The apparatus according to claim 1, further comprising an arithmetic device for calculating aberration of said projection optical system on the basis of a measurement result of said measurement device.

25 3. The apparatus according to claim 1, further comprising an arithmetic device for calculating ray aberration of said projection optical system on the

basis of a measurement result of said measurement device.

4. The apparatus according to claim 1, further comprising an arithmetic device for calculating

5 wavefront aberration of said projection optical system on the basis of a measurement result of said measurement device.

5. The apparatus according to claim 1, wherein said optical element is arranged near the object

10 plane of said projection optical system, and said mask is arranged near the image plane of said projection optical system.

6. The apparatus according to claim 5, wherein said optical element includes a mask having a

15 transmission portion, and light is emitted toward said projection optical system by illuminating said mask serving as said optical element by an illumination system.

7. The apparatus according to claim 1, wherein said optical element is arranged near the image

20 plane of said projection optical system, and said mask is arranged near the object plane of said projection optical system.

8. The apparatus according to claim 7, wherein said optical element includes a mask having a

25 transmission portion, and light is emitted toward said projection optical

system by illuminating said mask serving as said optical element by an illumination system.

9. The apparatus according to claim 7, wherein the projection exposure apparatus further

5 comprises an illumination system,  
said optical element includes a reflecting member,  
and

said reflecting member reflects, toward said projection optical system, light which is emitted by  
10 said illumination system and is incident on said reflecting member via said projection optical system.

10. The apparatus according to claim 9, further comprising a reflecting mirror for deflecting light which emerges from said optical element and passes  
15 through said projection optical system, and guiding the light to said mask.

11. The apparatus according to claim 1, wherein said optical element is arranged near the object plane of said projection optical system,

20 said mask is arranged near a plane conjugate to the object plane of said projection optical system,

the projection exposure apparatus further comprises a first reflecting mirror arranged on the image plane side of said projection optical system, and  
25 a second reflecting mirror for reflecting, toward said measurement device, light which is reflected by said first reflecting mirror and passes through said

projection optical system, and

light which emerges from said optical element  
passes through said projection optical system, is  
reflected by said first reflecting mirror, passes  
5 through said projection optical system again, is  
reflected by said second reflecting mirror, and guided  
to said mask.

12. The apparatus according to claim 1, wherein  
said optical element and said mask are arranged  
10 near the object plane of said projection optical system,  
the projection exposure apparatus further  
comprises a reflecting mirror arranged on the image  
plane side of said projection optical system, and  
light which emerges from said optical element  
15 passes through said projection optical system, is  
reflected by said reflecting mirror, passes through  
said projection optical system again, and is guided to  
said mask.

13. The apparatus according to claim 1, wherein  
20 said optical element and said mask are arranged  
near the image plane of said projection optical system,  
the projection exposure apparatus further  
comprises a reflecting mirror arranged on the object  
plane side of said projection optical system, and  
25 light which emerges from said optical element  
passes through said projection optical system, is  
reflected by said reflecting mirror, passes through

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said projection optical system again, and is guided to said mask.

14. The apparatus according to claim 1, wherein a predetermined region near the image plane or object

5 plane of said projection optical system falls within an isoplanatic region of said projection optical system.

15. The apparatus according to claim 1, wherein light which emerges from a predetermined region near the image plane or object plane of said projection optical

10 system sufficiently covers a pupil of said projection optical system.

16. A projection exposure apparatus comprising:

an illumination system;

15 a projection optical system for projecting a pattern on a substrate;

a holding portion for holding a first mask having a first transmission portion between said illumination system and said projection optical system;

20 a second mask which is arranged near an image-side focal position of said projection optical system and has a second transmission portion;

an actuator for driving said second mask along an image plane of said projection optical system; and

25 a measurement device for measuring a change in intensity of light which is emitted by said illumination system and passes through the first transmission portion, said projection optical system,

and the second transmission portion while said second mask is driven.

17. The apparatus according to claim 16, further comprising an arithmetic device for calculating  
5 aberration of said projection optical system on the basis of a measurement result of said measurement device.

18. The apparatus according to claim 16, further comprising an arithmetic device for calculating ray  
10 aberration of said projection optical system on the basis of a measurement result of said measurement device.

19. The apparatus according to claim 16, further comprising an arithmetic device for calculating  
15 wavefront aberration of said projection optical system on the basis of a measurement result of said measurement device.

20. The apparatus according to claim 16, further comprising an imaging optical system for imaging an  
20 exit pupil of said projection optical system on a measurement surface of said measurement device.

21. The apparatus according to claim 20, wherein said actuator drives said measurement device and said imaging optical system together with said second mask.

25 22. The apparatus according to claim 20, wherein said second mask, said imaging optical system, and said measurement device constitute an integral

measurement unit, and

said actuator drives said measurement unit along the image plane of said projection optical system.

23. The apparatus according to claim 16, wherein said  
5 first mask has a plurality of first transmission portions.

24. The apparatus according to claim 16, wherein said  
first mask has a transfer pattern to be transferred to the substrate, in addition to the first transmission  
10 portion.

25. A projection exposure apparatus comprising:  
an illumination system;  
a projection optical system for projecting a pattern on a substrate;  
15 a first holding portion for holding a first mask having a first transmission portion between said illumination system and said projection optical system;  
a first reflecting mirror arranged on an image plane side of said projection optical system;  
20 a second mask which is arranged between said illumination system and said projection optical system and has a second transmission portion;  
a second reflecting mirror for deflecting, toward the second transmission portion, light which is emitted  
25 by said illumination system, passes through the first transmission portion and said projection optical system, is reflected by said first reflecting mirror, and

passes through said projection optical system again;

an actuator for driving said second mask in a predetermined plane; and

5 a measurement device for measuring an intensity of light which is emitted by said illumination system, passes through the first transmission portion of said first mask and said projection optical system, is reflected by said first reflecting mirror, passes through said projection optical system again, is  
10 reflected by said second reflecting mirror, and passes through the second transmission portion of said second mask while said second mask is driven.

26. The apparatus according to claim 25, further comprising an arithmetic device for calculating  
15 aberration of said projection optical system on the basis of a measurement result of said measurement device.

27. The apparatus according to claim 25, further comprising an arithmetic device for calculating ray  
20 aberration of said projection optical system on the basis of a measurement result of said measurement device.

28. The apparatus according to claim 25, further comprising an arithmetic device for calculating  
25 wavefront aberration of said projection optical system on the basis of a measurement result of said measurement device.



29. The apparatus according to claim 25, wherein said first reflecting mirror includes a spherical mirror.

30. The apparatus according to claim 25, wherein said second reflecting mirror includes a half-mirror which  
5 transmits light emitted by said illumination system toward said projection optical system, and reflects, toward the second transmission portion of said second mask, light which is reflected by said first reflecting mirror and passes through said projection optical  
10 system.

31. A projection exposure apparatus comprising:  
an illumination system;  
a projection optical system for projecting a pattern on a substrate;  
15 a holding portion for holding a first mask having a first transmission portion between said illumination system and said projection optical system;  
a second mask which is arranged near an object plane of said projection optical system and has a  
20 second transmission portion;

a reflecting mirror arranged on an image plane side of said projection optical system, light which is emitted by said illumination system, passes through the first transmission portion and said projection optical  
25 system, is reflected by said reflecting mirror, and passes through said projection optical system again being incident on the second transmission portion;

an actuator for driving said second mask along  
the object plane of said projection optical system; and

a measurement device for measuring an intensity  
of light which is emitted by said illumination system,  
5 passes through the first transmission portion and said  
projection optical system, is reflected by said  
reflecting mirror, passes through said projection  
optical system again, and passes through the second  
transmission portion while said second mask is driven.

10 32. The apparatus according to claim 31, further  
comprising an arithmetic device for calculating  
aberration of said projection optical system on the  
basis of a measurement result of said measurement  
device.

15 33. The apparatus according to claim 31, further  
comprising an arithmetic device for calculating ray  
aberration of said projection optical system on the  
basis of a measurement result of said measurement  
device.

20 34. The apparatus according to claim 31, further  
comprising an arithmetic device for calculating  
wavefront aberration of said projection optical system  
on the basis of a measurement result of said -  
measurement device.

25 35. The apparatus according to claim 31, wherein said  
reflecting mirror includes a spherical mirror.

36. A projection exposure apparatus comprising:

a substrate stage;

a projection optical system for projecting a pattern on a substrate on said substrate stage;

a first mask which is arranged between said  
5 projection optical system and said substrate stage and has a first transmission portion;

an illumination system for illuminating the first transmission portion;

a second mask which is arranged between said  
10 projection optical system and said substrate stage and has a second transmission portion;

a reflecting mirror arranged on an object side of said projection optical system, light which is emitted by said illumination system, passes through the first  
15 transmission portion and said projection optical system, is reflected by said reflecting mirror, and passes through said projection optical system again being incident on the second transmission portion;

an actuator for driving said second mask along an  
20 image plane of said projection optical system; and

a measurement device for measuring an intensity of light which is emitted by said illumination system, passes through the first transmission portion and said projection optical system, is reflected by said  
25 reflecting mirror, passes through said projection optical system again, and passes through the second transmission portion while said second mask is driven.

37. The apparatus according to claim 36, further comprising an arithmetic device for calculating aberration of said projection optical system on the basis of a measurement result of said measurement  
5 device.

38. The apparatus according to claim 36, further comprising an arithmetic device for calculating ray aberration of said projection optical system on the basis of a measurement result of said measurement  
10 device.

39. The apparatus according to claim 36, further comprising an arithmetic device for calculating wavefront aberration of said projection optical system on the basis of a measurement result of said  
15 measurement device.

40. The apparatus according to claim 36, wherein said reflecting mirror includes a spherical mirror.

41. A method of measuring aberration of a projection optical system in a projection exposure apparatus for  
20 projecting a pattern on a substrate via the projection optical system,

the projection exposure apparatus having  
a projection optical system for projecting a  
pattern on a substrate,

25 a holding portion for holding an optical element which propagates light toward the projection optical system, and

a mask which is arranged near an image plane or object plane of the projection optical system or a plane conjugate to the image plane and object plane and has a transmission portion,

5 the method comprising:

the measurement step of measuring an intensity of light which emerges from the optical element, and passes through the projection optical system and the transmission portion of the mask while the mask is

10 driven along a plane of an image of the optical element formed by the projection optical system; and

the arithmetic step of calculating aberration of the projection optical system on the basis of a measurement result obtained in the measurement step.

15 42. A method of measuring aberration of a projection optical system in a projection exposure apparatus for projecting a pattern on a substrate via the projection optical system,

the projection exposure apparatus having  
20 an illumination system,

a projection optical system for projecting a pattern on a substrate,

a holding portion for holding a first mask having a first transmission portion between the illumination  
25 system and the projection optical system, and

a second mask which is arranged near an image-side focal position of the projection optical

system and has a second transmission portion,

the method comprising:

the measurement step of measuring a change in  
intensity of light which is emitted by the illumination

5 system and passes through the first transmission  
portion, the projection optical system, and the second  
transmission portion while the second mask is driven  
along an image plane of the projection optical system;  
and

10 the arithmetic step of calculating aberration of  
the projection optical system on the basis of a  
measurement result obtained in the measurement step.

43. A method of measuring aberration of a projection  
optical system in a projection exposure apparatus for  
15 projecting a pattern on a substrate via the projection  
optical system,

the projection exposure apparatus having  
an illumination system,

a projection optical system for projecting a  
20 pattern on a substrate,

a first holding portion for holding a first mask  
having a first transmission portion between the  
illumination system and the projection optical system;

a first reflecting mirror arranged on an image  
25 plane side of the projection optical system,

a second mask which is arranged between the  
illumination system and the projection optical system

and has a second transmission portion, and

a second reflecting mirror for deflecting, toward the second transmission portion, light which is emitted by the illumination system, passes through the first transmission portion and the projection optical system, is reflected by the first reflecting mirror, and passes through the projection optical system again,

the method comprising:

the measurement step of measuring an intensity of light which is emitted by the illumination system, passes through the first transmission portion of the first mask and the projection optical system, is reflected by the first reflecting mirror, passes through the projection optical system again, is reflected by the second reflecting mirror, and passes through the second transmission portion of the second mask while the second mask is driven in a predetermined plane; and

the arithmetic step of calculating aberration of the projection optical system on the basis of a measurement result obtained in the measurement step.

44. A method of measuring aberration of a projection optical system in a projection exposure apparatus for projecting a pattern on a substrate via the projection optical system,

the projection exposure apparatus having an illumination system,

a projection optical system for projecting a pattern on a substrate,

a holding portion for holding a first mask having a first transmission portion between the illumination

5 system and the projection optical system,

a second mask which is arranged near an object plane of the projection optical system and has a second transmission portion, and

10 a reflecting mirror arranged on an image plane side of the projection optical system, light which is emitted by the illumination system, passes through the first transmission portion and the projection optical system, is reflected by the reflecting mirror, and passes through the projection optical system again

15 being incident on the second transmission portion

the method comprising:

the measurement step of measuring an intensity of light which is emitted by the illumination system, passes through the first transmission portion and the  
20 projection optical system, is reflected by the reflecting mirror, passes through the projection optical system again, and passes through the second transmission portion while the second mask is driven along the object plane of the projection optical  
25 system; and

the arithmetic step of calculating aberration of the projection optical system on the basis of a



measurement result obtained in the measurement step.

45. A method of measuring aberration of a projection optical system in a projection exposure apparatus for projecting a pattern on a substrate via the projection

5 optical system,

the projection exposure apparatus having  
a substrate stage,

a projection optical system for projecting a  
pattern on a substrate on the substrate stage,

10 a first mask which is arranged between the  
projection optical system and the substrate stage and  
has a first transmission portion,

an illumination system for illuminating the first  
transmission portion,

15 a second mask which is arranged between the  
projection optical system and the substrate stage and  
has a second transmission portion, and

a reflecting mirror arranged on an object side of  
the projection optical system, light which is emitted  
20 by the illumination system, passes through the first  
transmission portion and the projection optical system,  
is reflected by the reflecting mirror, and passes  
through the projection optical system again being  
incident on the second transmission portion,

25 the method comprising:

the measurement step of measuring an intensity of  
light which is emitted by the illumination system,

passes through the first transmission portion and the projection optical system, is reflected by the reflecting mirror, passes through the projection optical system again, and passes through the second transmission portion while the second mask is driven along an image plane of the projection optical system; and

the arithmetic step of calculating aberration of the projection optical system on the basis of a measurement result obtained in the measurement step.

46. A transfer method of transferring a pattern to a substrate by using a projection exposure apparatus,

the projection exposure apparatus having a projection optical system for projecting a pattern on a substrate,

a holding portion for holding an optical element which propagates light toward the projection optical system, and

a mask which is arranged near an image plane or object plane of the projection optical system or a plane conjugate to the image plane and object plane and has a transmission portion,

the method comprising:

the measurement step of measuring an intensity of light which emerges from the optical element, and passes through the projection optical system and the transmission portion of the mask while the mask is

driven along a plane of an image of the optical element  
formed by the projection optical system;

the arithmetic step of calculating aberration of  
the projection optical system on the basis of a

5 measurement result obtained in the measurement step;

the adjustment step of adjusting the projection  
optical system on the basis of aberration obtained in  
the arithmetic step; and

the transfer step of transferring a pattern to  
10 the substrate by using the projection exposure  
apparatus in which the projection optical system is  
adjusted.

47. A transfer method of transferring a pattern to a  
substrate by using a projection exposure apparatus,

15 the projection exposure apparatus having  
an illumination system,

a projection optical system for projecting a  
pattern on a substrate,

a holding portion for holding a first mask having  
20 a first transmission portion between the illumination  
system and the projection optical system, and

a second mask which is arranged near an  
image-side focal position of the projection optical  
system and has a second transmission portion,

25 the method comprising:

the measurement step of measuring a change in  
intensity of light which is emitted by the illumination

system and passes through the first transmission portion, the projection optical system, and the second transmission portion while the second mask is driven along an image plane of the projection optical system;

- 5           the arithmetic step of calculating aberration of the projection optical system on the basis of a measurement result obtained in the measurement step;

          the adjustment step of adjusting the projection optical system on the basis of aberration obtained in  
10   the arithmetic step; and

          the transfer step of transferring a pattern to the substrate by using the projection exposure apparatus in which the projection optical system is adjusted.

- 15   48.   A transfer method of transferring a pattern to a substrate by using a projection exposure apparatus,

          the projection exposure apparatus having an illumination system,

- a projection optical system for projecting a  
20   pattern on a substrate,

          a first holding portion for holding a first mask having a first transmission portion between the illumination system and the projection optical system;

- a first reflecting mirror arranged on an image  
25   plane side of the projection optical system,

          a second mask which is arranged between the illumination system and the projection optical system

and has a second transmission portion, and

a second reflecting mirror for deflecting, toward the second transmission portion, light which is emitted by the illumination system, passes through the first

- 5 transmission portion and the projection optical system, is reflected by the first reflecting mirror, and passes through the projection optical system again,

the method comprising:

- the measurement step of measuring an intensity of
- 10 light which is emitted by the illumination system, passes through the first transmission portion of the first mask and the projection optical system, is reflected by the first reflecting mirror, passes through the projection optical system again, is
- 15 reflected by the second reflecting mirror, and passes through the second transmission portion of the second mask while the second mask is driven in a predetermined plane;

- the arithmetic step of calculating aberration of
- 20 the projection optical system on the basis of a measurement result obtained in the measurement step;

the adjustment step of adjusting the projection optical system on the basis of aberration obtained in the arithmetic step; and

- 25 the transfer step of transferring a pattern to the substrate by using the projection exposure apparatus in which the projection optical system is

adjusted.

49. A transfer method of transferring a pattern to a substrate by using a projection exposure apparatus,

the projection exposure apparatus having

5 an illumination system,

a projection optical system for projecting a pattern on a substrate,

a holding portion for holding a first mask having a first transmission portion between the illumination

10 system and the projection optical system,

a second mask which is arranged near an object plane of the projection optical system and has a second transmission portion, and

a reflecting mirror arranged on an image plane  
15 side of the projection optical system, light which is emitted by the illumination system, passes through the first transmission portion and the projection optical system, is reflected by the reflecting mirror, and passes through the projection optical system again

20 being incident on the second transmission portion

the method comprising:

the measurement step of measuring an intensity of light which is emitted by the illumination system, passes through the first transmission portion and the  
25 projection optical system, is reflected by the reflecting mirror, passes through the projection optical system again, and passes through the second

transmission portion while the second mask is driven along the object plane of the projection optical system;

the arithmetic step of calculating aberration of  
5 the projection optical system on the basis of a measurement result obtained in the measurement step;

the adjustment step of adjusting the projection optical system on the basis of aberration obtained in the arithmetic step; and

10 the transfer step of transferring a pattern to the substrate by using the projection exposure apparatus in which the projection optical system is adjusted.

50. A transfer method of transferring a pattern to a  
15 substrate by using a projection exposure apparatus, the projection exposure apparatus having a substrate stage,

a projection optical system for projecting a pattern on a substrate on the substrate stage,  
20 a first mask which is arranged between the projection optical system and the substrate stage and has a first transmission portion,

an illumination system for illuminating the first transmission portion,

25 a second mask which is arranged between the projection optical system and the substrate stage and has a second transmission portion, and

a reflecting mirror arranged on an object side of the projection optical system, light which is emitted by the illumination system, passes through the first transmission portion and the projection optical system, is reflected by the reflecting mirror, and passes through the projection optical system again being incident on the second transmission portion,

the method comprising:

the measurement step of measuring an intensity of light which is emitted by the illumination system, passes through the first transmission portion and the projection optical system, is reflected by the reflecting mirror, passes through the projection optical system again, and passes through the second transmission portion while the second mask is driven along an image plane of the projection optical system;

the arithmetic step of calculating aberration of the projection optical system on the basis of a measurement result obtained in the measurement step; the adjustment step of adjusting the projection optical system on the basis of aberration obtained in the arithmetic step; and

the transfer step of transferring a pattern to the substrate by using the projection exposure apparatus in which the projection optical system is adjusted.

51. A method of manufacturing a device by using a



projection exposure apparatus,

the projection exposure apparatus having

a projection optical system for projecting a  
pattern on a substrate,

- 5 a holding portion for holding an optical element  
which propagates light toward the projection optical  
system, and

- a mask which is arranged near an image plane or  
object plane of the projection optical system or a  
10 plane conjugate to the image plane and object plane and  
has a transmission portion,

the method comprising:

- the measurement step of measuring an intensity of  
light which emerges from the optical element, and  
15 passes through the projection optical system and the  
transmission portion of the mask while the mask is  
driven along a plane of an image of the optical element  
formed by the projection optical system;

- the arithmetic step of calculating aberration of  
20 the projection optical system on the basis of a  
measurement result obtained in the measurement step;

the adjustment step of adjusting the projection  
optical system on the basis of the aberration obtained  
in the arithmetic step;

- 25 the transfer step of transferring a pattern to a  
photosensitive member of the substrate coated with the  
photosensitive member by using the projection exposure

apparatus in which the projection optical system is adjusted; and

the developing step of developing the photosensitive member bearing the pattern.

- 5 52. A method of manufacturing a device by using a projection exposure apparatus,

the projection exposure apparatus having an illumination system,

- 10 a projection optical system for projecting a pattern on a substrate,

a holding portion for holding a first mask having a first transmission portion between the illumination system and the projection optical system, and

- 15 a second mask which is arranged near an image-side focal position of the projection optical system and has a second transmission portion,

the method comprising:

- 20 the measurement step of measuring a change in intensity of light which is emitted by the illumination system and passes through the first transmission portion, the projection optical system, and the second transmission portion while the second mask is driven along an image plane of the projection optical system;

- 25 the arithmetic step of calculating aberration of the projection optical system on the basis of a measurement result obtained in the measurement step;

the adjustment step of adjusting the projection

optical system on the basis of the aberration obtained in the arithmetic step;

the transfer step of transferring a pattern to a photosensitive member of the substrate coated with the photosensitive member by using the projection exposure apparatus in which the projection optical system is adjusted; and

the developing step of developing the photosensitive member bearing the pattern.

53. A method of manufacturing a device by using a projection exposure apparatus,
- the projection exposure apparatus having an illumination system,
- a projection optical system for projecting a pattern on a substrate,
- a first holding portion for holding a first mask having a first transmission portion between the illumination system and the projection optical system;
- a first reflecting mirror arranged on an image plane side of the projection optical system,
- a second mask which is arranged between the illumination system and the projection optical system and has a second transmission portion, and
- a second reflecting mirror for deflecting, toward the second transmission portion, light which is emitted by the illumination system, passes through the first transmission portion and the projection optical system,

is reflected by the first reflecting mirror, and passes through the projection optical system again,

the method comprising:

the measurement step of measuring an intensity of

- 5 light which is emitted by the illumination system, passes through the first transmission portion of the first mask and the projection optical system, is reflected by the first reflecting mirror, passes through the projection optical system again, is
- 10 reflected by the second reflecting mirror, and passes through the second transmission portion of the second mask while the second mask is driven in a predetermined plane;

- the arithmetic step of calculating aberration of
- 15 the projection optical system on the basis of a measurement result obtained in the measurement step;

the adjustment step of adjusting the projection optical system on the basis of the aberration obtained in the arithmetic step;

- 20 the transfer step of transferring a pattern to a photosensitive member of the substrate coated with the photosensitive member by using the projection exposure apparatus in which the projection optical system is adjusted; and

- 25 the developing step of developing the photosensitive member bearing the pattern.

54. A method of manufacturing a device by using a

projection exposure apparatus,

the projection exposure apparatus having  
an illumination system,

a projection optical system for projecting a  
5 pattern on a substrate,

a holding portion for holding a first mask having  
a first transmission portion between the illumination  
system and the projection optical system,

a second mask which is arranged near an object  
10 plane of the projection optical system and has a second  
transmission portion, and

a reflecting mirror arranged on an image plane  
side of the projection optical system, light which is  
emitted by the illumination system, passes through the  
15 first transmission portion and the projection optical  
system, is reflected by the reflecting mirror, and  
passes through the projection optical system again  
being incident on the second transmission portion

the method comprising:

20 the measurement step of measuring an intensity of  
light which is emitted by the illumination system,  
passes through the first transmission portion and the  
projection optical system, is reflected by the  
reflecting mirror, passes through the projection  
25 optical system again, and passes through the second  
transmission portion while the second mask is driven  
along the object plane of the projection optical

system;

the arithmetic step of calculating aberration of the projection optical system on the basis of a measurement result obtained in the measurement step;

- 5        the adjustment step of adjusting the projection optical system on the basis of the aberration obtained in the arithmetic step;

- 10       the transfer step of transferring a pattern to a photosensitive member of the substrate coated with the photosensitive member by using the projection exposure apparatus in which the projection optical system is adjusted; and

the developing step of developing the photosensitive member bearing the pattern.

- 15    55. A method of manufacturing a device by using a projection exposure apparatus,

the projection exposure apparatus having a substrate stage,

- 20       a projection optical system for projecting a pattern on a substrate on the substrate stage,

a first mask which is arranged between the projection optical system and the substrate stage and has a first transmission portion,

- 25       an illumination system for illuminating the first transmission portion,

a second mask which is arranged between the projection optical system and the substrate stage and

has a second transmission portion, and

a reflecting mirror arranged on an object side of the projection optical system, light which is emitted by the illumination system, passes through the first transmission portion and the projection optical system, is reflected by the reflecting mirror, and passes through the projection optical system again being incident on the second transmission portion,

the method comprising:

the measurement step of measuring an intensity of light which is emitted by the illumination system, passes through the first transmission portion and the projection optical system, is reflected by the reflecting mirror, passes through the projection optical system again, and passes through the second transmission portion while the second mask is driven along an image plane of the projection optical system;

the arithmetic step of calculating aberration of the projection optical system on the basis of a

measurement result obtained in the measurement step;

the adjustment step of adjusting the projection optical system on the basis of the aberration obtained in the arithmetic step;

the transfer step of transferring a pattern to a photosensitive member of the substrate coated with the photosensitive member by using the projection exposure apparatus in which the projection optical system is

adjusted; and

the developing step of developing the  
photosensitive member bearing the pattern.

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